REMARKS

Please reconsider the application in view of the above amendments and the following remarks. Applicant thanks the Examiner for carefully considering this application.

Disposition of Claims

Claims 1-21, 23, 25-45, 47, 49-67, 69, 71, and 74-76 are pending in this application. Claims 1, 26, and 50 are independent. The remaining claims depend, directly or indirectly, from claims 1, 26, and 50.

Claim Amendments

Claims 1, 26, and 50 have been amended for clarity. Support for these amendments, for example, may be found in the specification on pages 16 and 17, as well as FIG. 8. No new matter is introduced by these amendments.

Rejection(s) under 35 U.S.C § 103

A. Claims 1-18, 20, 23, 25-42, 44, 47, 49-64, 66, 69, 71, and 72-74 were rejected under 35 U.S.C. § 103 as being obvious over Palmberg (U.S. Patent No. 5,794,728) in view of Keshavan (U.S. Patent No. 5,370,342) or Hedlund (U.S. Patent No. 5,575,3420. Claims 1, 26, and 50 have been amended in this reply to clarify the present invention. To the extent that this rejection may still apply to the amended claims, the rejection is respectfully traversed.

The present invention relates to percussion bits having different sized inserts. In one aspect, different sized inserts are used to avoid "catastrophic internal fatigue cracking," i.e., breakage or significant fracture of a bit head.

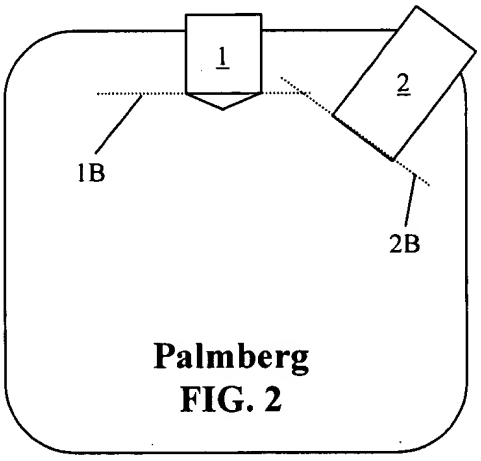
A percussion bit typically comprises a bit head that includes a plurality of cavities, in which inserts are disposed. When a cavity is made in a bit body, the edge of the bottom of the cavity creates a weak point, which is very susceptible to fracture. The fatigue crack that develops from the corner (edge) often propagates along a base plane, the plane defined by the corners in the lower portion of the cavity. If the base planes of adjacent cavities intercept in a section of the bit body between the adjacent cavities, the fatigue cracks that initiate at adjacent corners have a close path of least resistance extending between adjacent cavities and are susceptible to joinder with one another, which can lead to catastrophic internal fatigue cracking. (Specification, p. 16, lines 14-20).

It has been discovered by the inventors of the present invention that the use of small and large inserts disposed in adjacent cavities at sufficiently different depths as illustrated in FIG. 8 will avoid this problem. In accordance with one embodiment of the present invention, "the base planes 62 of adjacent cavities 50 carrying large and small inserts 32, 22 do not intersect in the bit section 65 between the cavities 50. Further, the adjacent base corners 58 of adjacent cavities 50 are separated by a distance 66 that is greater than the distance 64 of the adjacent base corners 58 of adjacent cavities 50 of the typical prior art bit 10 (FIG. 7)." (Specification, p. 16, line 21 – p. 17, line 6).

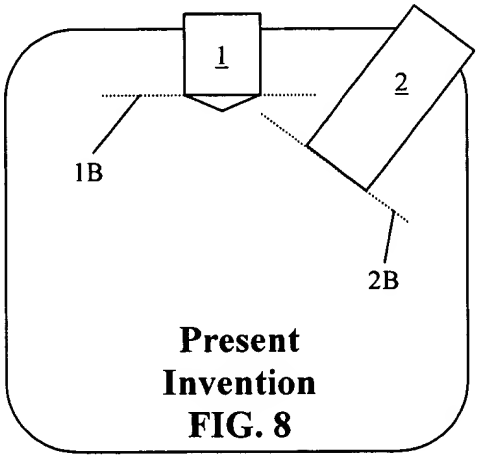
The following diagram illustrates a prior art bit (e.g., Palmberg, FIG. 2) and a bit of the present invention (as shown in FIG. 8). Figure 2 of Palmberg shows the relative depths of the larger gauge inserts and the center insert. Palmberg is silent on the relative depths of adjacent inserts. In the prior art bit, base planes (the planes that intercept the corners near the bottoms of the cavities) of the center insert cavity 1 and gauge insert cavity 2 intercept in a region between the two cavities. Palmberg neither shows nor suggests that the relative depths of adjacent insert

cavities may have a different relationship. A fracture that initiates from the weakest point (the bottom edge) in cavity 1 will likely travel along base plane 1B, while a fracture that develops from the weakest point in cavity 2 will propagate along base plane 2B. Because bases planes 1B and 2B intercept in a region between the adjacent cavities, it is more likely that such fractures will find the least resistant path to meet in the region between the two cavities 1 and 2. This will lead to catastrophic internal fatigue cracks.

In contrast, a bit in accordance with one embodiment of the invention (FIG. 8) does not have the base planes 1B and 2B intercept in a region between the two adjacent cavities 1 and 2. Therefore, fractures that may develop from corners of the cavities are less likely to meet in the region between the two cavities. This reduces the probability of catastrophic internal fatigue cracks. Note that a percussion bit having one or more cavities arranged to avoid base planes intercepting in regions between adjacent cavities will have advantages disclosed in the present invention; there is no need to have all cavities so configured.



Palmberg
FIG. 2



Present Invention
FIG. 8

Independent claims 1, 26, and 50 have been amended to include the limitation, "wherein the depth of the second cavities is greater than the depth of the first cavities such that base planes

of two adjacent cavities that are selected one each from the first cavities and the second cavities do not intercept in a bit section between the two adjacent cavities."

Palmberg discloses percussion rock drill bits that include better fluid passages so that rock cuttings can be more efficiently removed. Palmberg also discloses percussion bits that include larger tungsten carbide inserts in the gauge row. However, the bits of Palmberg, like those in the prior art, have the cavities in such configurations that base planes from adjacent cavities intercept in a region between the adjacent cavities (see FIG. 2). Palmberg does not teach or suggest having base planes of adjacent cavities arranged in a configuration to avoid having these base planes intercept in a region between the adjacent cavities. With reference to Figures 2 and 5 of Palmberg, Applicant draws the Examiner's attention to the attached Declaration of Lance Underwood. As noted in that declaration, in Figure 2 of Palmberg the inserts shown are not in adjacent cavities, so the cavities are far enough apart that fatigue cracks are not likely to propagate between the two. In Figure 5 of Palmberg, the insert cavity base planes do not intersect between the cavities, but this is by virtue of the fact that the cavities are far apart, not by virtue of the fact that they are of different depths. Palmberg is silent on the subject of the use of different hole depths on adjacent cavities to prevent base planes from intersecting.

As noted in § 11 of the Declaration, Skidmore is silent on fatigue cracking and clearly shows adjacent cavities with base planes that will intercept between those adjacent cavities.

Keshavan et al. discloses *roller cone* drill bit inserts enhanced with polycrystalline diamond. It does not disclose what is missing in Palmberg. Similarly, Hedlund discloses inserts having hardfacing; it also fails to provide what is missing in Palmberg.

The combination of Palmberg and Keshavan or Hedlund is improper for a lack of motivation to combine. The Examiner asserts that it would be obvious to enhance the inserts of

Palmberg with a PCD layer as taught in Keshavan or Hedlund. However, Palmberg is silent on the use of any material for an insert besides tungsten carbide. Further, Palmberg specifically states that big gauge inserts are used "partly to facilitate the regrinding process (column 1, lines 44-45)." The ability to regrind an insert is available with tungsten carbide inserts, but is not available for the PCD enhanced inserts disclosed in the present invention because grinding would destroy the PCD layer. Keshavan teaches the use of PCD enhanced inserts for roller cone drill bits, which are exposed to entirely different loads from those experienced by a percussive drill bit during drilling. Hedlund also fails to disclose the use of large PCD enhanced inserts. The reasoning provided by Palmberg for the use of large tungsten carbide inserts does not suggest to one of ordinary skill in the art that PCD enhanced inserts may be useful. Thus, one of ordinary skill in the art would not be motivated to combine the teachings of Palmberg and Keshavan or Hedlund. Accordingly, this combination cannot be properly used to render any claim as obvious.

Further evidence of a lack of motivation to combine is shown by the particular properties of inserts with enhanced surfaces. One special concern with the use of an enhanced surface on inserts is the occurrence of highly concentrated contact stresses (page 12, line 9-21). This is a particular concern for percussive bits. High contact stresses can cause micro-chipping, spalling, and fracture of the enhanced surface. The present inventors have found that increasing the radius of curvature greatly improves the longevity of inserts with enhanced surfaces. The tungsten carbide inserts disclosed by Palmberg do not exhibit these characteristics. Hedlund and Keshavan (because Keshavan relates to roller cone drill bits) are silent on these characteristics as well. Thus, one of ordinary skill in the art would not be motivated to combine the teachings of Palmberg and Keshavan or Hedlund. Accordingly, this combination cannot be properly used to

render any claim as obvious.

Another concern with the use of inserts with enhanced surfaces, is the existence of residual stresses between the enhanced surface and the tungsten carbide substrate caused by the mismatch of the thermal expansion coefficients of the two materials (page 12, line 22 to page 13, line 10). The residual stresses weaken the enhanced surface and the tungsten carbide substrate, which increases the insert's susceptibility to breakage and failure. The present inventors have found that the magnitude of residual stress is proportional to the radius of the substrate. The tungsten carbide inserts disclosed by Palmberg do not exhibit these characteristics. Thus, one of ordinary skill in the art would not be motivated to combine the teachings of Palmberg and Keshavan or Hedlund. Accordingly, this combination cannot be properly used to render any claim as obvious.

Therefore, amended claims 1, 26, and 50 are patentable over Palmberg, Keshavan et al. and Hedlund, whether considered separately or in combination. Claims 2-18, 20, 23, 25, 27-42, 44, 47, 49, 51-64, 66, 69, 71, and 72-74, which depend from claims 1, 26, and 50, should be patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

B. Claims 1-18, 20, 21, 23, 25-42, 44, 45, 47, 49-64, 66, 67, 69, 71, and 74-76 were rejected under 35 U.S.C. § 103 as being obvious over Skidmore (U.S. Patent No. 3,955,635) in view of Keshavan et al. (U.S. 5,370,195) or Hedlund (U.S. 5,575,342) and Palmberg (U.S. 5,794,728) or Hughes (GB 1,507,163) or Liljekvist et al. (EP 0140849). Claims 1, 26, and 50 have been amended in this reply to clarify the present invention recited. To the extent that this rejection may still apply to the amended claims, the rejection is respectfully traversed.

Skidmore discloses percussion drill bits that may include different sized tungsten carbide inserts. However, Skidmore fails to teach or suggest having base planes of adjacent cavities arranged in a configuration to avoid having these base planes intercept in a region between the adjacent cavities. Skidmore is silent on the relative depths of adjacent cavities, and does not illustrate the depths of the cavities in any of the figures. With reference to Figure 1 of Skidmore, Applicant again draws the attention of the Examiner to the attached Declaration. As noted in § 11 of the Declaration, Skidmore is silent on fatigue cracking and only shows a large insert that protrudes further from the body than the adjacent smaller insert, which makes it likely that the cavity is not at a sufficiently different depth to prevent fatigue crack propagation.

As noted above, Keshavan et al., Hedlund, and Palmberg also fail to teach or suggest having base planes of adjacent cavities arranged in a configuration to avoid having these base planes intercept in a region between the adjacent cavities.

As noted above, there is no motivation to combine the teachings of Palmberg relating to the use of large tungsten carbide inserts with the teachings of Keshavan or Hedlund. Similarly, Skidmore teaches the use of large tungsten carbide inserts. Thus, one of ordinary skill in the art would not be motivated to combine the teachings of Skidmore and Keshavan or Hedlund. Accordingly, this combination cannot be properly used to render any claim as obvious.

Hughes discloses rotary percussion earth boring bits with various insert configurations. Hughes does not teach or suggest having base planes of adjacent cavities arranged in a configuration in order to avoid having these base planes intercept in a region between the adjacent cavities.

Liljekvist discloses a rock drill bit of the impact type in which each insert is provided with a guiding surface that mainly coincides with the jacket surface of the boring head. (Col. 1,

line 61 – col. 2, line 3). Liljekvist does not teach or suggest having base planes of adjacent cavities arranged in a configuration to avoid having these base planes intercept in a region between the adjacent cavities.

Therefore, amended claims 1, 26, and 50 are patentable over Skidmore, Keshavan et al., Hedlund, Palmberg, Hughes and Liljekvist, whether considered separately or in combination. Claims 2-18, 20, 21, 23, 25, 27-42, 44, 45, 47, 49, 51-64, 66, 67, 69, 71, and 74-76, which depend from claims 1, 26, and 50, should be patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

C. Claims 1-19, 21, 23, 25-43, 45, 47, 49-65, 67, 69, 71, and 74-76 were rejected under 35 U.S.C. § 103 as being obvious over Isakov (U.S. Patent No. 4,716,976) in view of Keshavan et al. (U.S. 5,370,195) or Hedlund (U.S. 5,575,342) and Palmberg (U.S. 5,794,728) or Hughes (GB 1,507,163) or Liljekvist et al. (EP 0140849). Claims 1, 26, and 50 have been amended in this reply to clarify the present invention recited. To the extent that this rejection may still apply to the amended claims, the rejection is respectfully traversed.

Isakov discloses rotary percussion drill bits that include asymmetrically ridged inserts. However, Isakov does not teach or suggest having base planes of adjacent cavities arranged in a configuration to avoid having these base planes intercept in a region between the adjacent cavities.

As noted above, Keshavan et al., Hedlund, Palmberg, Hughes, and Liljekvist also fail to teach or suggest having base planes of adjacent cavities arranged in a configuration to avoid having these base planes intercept in a region between the adjacent cavities.

Therefore, amended claims 1, 26, and 50 are patentable over Isakov, Keshavan et al.,

Hedlund, Palmberg, Hughes and Liljekvist, whether considered separately or in combination. Claims 2-19, 21, 23, 25, 27-43, 45, 47, 49, 51-65, 67, 69, 71, and 74-76, which depend from claims 1, 26, and 50, should be patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Applicant believes this reply is fully responsive to all outstanding issues and places this application in condition for allowance. If this belief is incorrect, or other issues arise, the Examiner is encouraged to contact the undersigned or his associates at the telephone number listed below. Because the amendments and remarks simplify the issues for allowance or appeal, and do not constitute new matter, entry and consideration thereof is respectfully requested. Please apply any charges not covered, or any credits, to Deposit Account 50-0591 (Reference Number 05516/179001).

Respectfully submitted,

Date: 8/27/04

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant :	John Adam MEYERS, et al.	Art Unit :	3672
Serial No.:	09/104,788	Examiner :	H. C. Dang
Filed :	June 25, 1998		
Title :	DRILL BIT WITH LARGE INSERTS		

22511
PATENT TRADEMARK OFFICE

Assistant Commissioner for Patents
Washington, DC 20231

DECLARATION OF LANCE UNDERWOOD UNDER 37 CFR § 1.132

I, Lance Underwood, hereby declare that:

1. I received a Bachelor's Degree in Engineering Technology (Mechanical) from California Sate Polytechnic University, Pomona in 1980.

2. I have worked in the field of Mechanical Engineering for 23 years and throughout that time have been closely involved in the field of material science. Since 1980, I have been involved in the design, development, and testing of drill bits, mud motors, adjustable stabilizers, air hammers, and other downhole drilling tools.

4. I am familiar with the above referenced patent application, and have reviewed the Examiner's rejections.

5. I am currently employed by Smith International, Inc.

6. I am not a listed inventor on the present application.

7. As I understand, U.S. Patent No. 5,794,728 ("Palmberg"), a primary teaching of Palmberg, with respect to inserts, is to provide a percussion drill bit having larger gauge inserts (up to 30 percent of bit diameter) than central inserts. The inserts are placed into cavities on the drill bit that have depths that are proportional to the size of the corresponding insert. Palmberg teaches that the use of large gauge inserts provides large chipways to clear away cuttings to increase the average size of cuttings by preventing

regrinding of cuttings. Palmberg also teaches that the use of large tungsten carbide inserts facilitates regrinding of the inserts for continued use.

8. As I understand, U.S. Patent No. 3,955,635 ("Skidmore"), a primary teaching of Skidmore, with respect to inserts, is to use large tungsten carbide inserts that are widely spaced apart on the bit face. Larger inserts are used as gauge inserts (referred to as peripheral inserts by Skidmore). This arrangement of large inserts is used to promote the fragmentation of large rock chips.

9. To my knowledge percussion drill bits are prone to the propagation of fatigue cracks while drilling. One source for the start of the cracks is in the base of each cavity for an insert, which receives the drilling impact force in a location with reduced material cross-section. These cracks typically spread out along the base plane of each cavity. When neighboring cracks meet, they join and spread further, which can lead to catastrophic fatigue failure of the percussion drill bit.

10. As a person of at least ordinary skill in the art, I believe that neither Palmberg nor Skidmore show or suggest varying the depths of inserts such that the base planes of two adjacent cavities do not intercept between the two adjacent cavities, as recited in the present claims.

11. Both Palmberg and Skidmore are silent on the occurrence of fatigue cracks forming in the body of a percussion drill bit. In Figure 2 of Palmberg the inserts shown are not in adjacent cavities, so the cavities are far enough apart that fatigue cracks are not likely to propagate between the two. In Figure 5 of Palmberg, the insert cavity base planes do not intersect between the cavities, but this is by virtue of the fact that the cavities are far apart, not by virtue of the fact that they are of different depths. Palmberg is silent on the subject of the use of different hole depths on adjacent cavities to prevent base planes from intersecting. In Figure 1, Skidmore shows larger gauge inserts that protrude further from the body of the bit. Because the larger gauge inserts protrude further, one would

expect that the cavity in which the gauge insert rests is at a shallower depth than the large inserts disclosed in the application. Skidmore does not show or suggest otherwise.

I further declare that all statements made herein of my own knowledge are true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Lance D Ulschmid

Date: 8/27/2004

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